CASE STUDY

ENHANCED SAFETY & BNR: FL WWTP MIGRATES FROM METHANOL TO NON-HAZARDOUS MICROC® 2000

A Florida municipal wastewater treatment facility using an aging methanol system for biological nitrogen removal switches to non-hazardous MicroC® 2000 carbon sources, avoiding an expensive methanol-system upgrade, maintaining regulatory compliance — and eliminating the need for chemical treatment of phosphorus.

Client: Large Municipal Advanced Wastewater Treatment Plant

Location: Florida

Flow Design/Actual: 10 MGD/8 MGD

Treatment Technology: **2-Stage Activated** Sludge Process with Denitrification

Target Total Nitrogen Concentration: <3 mg/L

Study Period: October-February

Background: Rising Methanol Risks & Capitol Costs

The Florida municipal wastewater treatment plant using methanol for many years as the supplemental carbon source needed to support denitrification for biological nitrogen removal (BNR) was faced with upgrading their aging methanol facility and equipment. Methanol's inherent safety and toxicity risks typically involve expensive capital infrastructure and equipment, and strict regulatory requirements regarding storage, handling, and minimizing environmental impact.

Faced with safety risk, high upgrade cost, and low efficiency of continuing with methanol as a carbon source, treatment plant operators chose



instead to switch to a safer, non-flammable supplemental carbon source: EOSi's MicroC® 2000. Supporting both denitrification and biological phosphorus removal, non-hazardous MicroC 2000 eliminates flammability and toxicity concerns of using methanol, delivers substantial capital cost savings over flammable liquid storage and feed systems, and enables rapid and flexible deployment of advanced carbon augmentation solutions.

Challenge

Unlike most municipal WWTPs with BNR, this treatment plant has a 2-sludge system in which the denitrifying sludge is separate from the nitrifying activated sludge. The denitrifying sludge had become a specialized biomass dominated by methylotrophic bacteria that were highly acclimated to methanol.

These methylotrophic bacteria were not expected to survive a switch to a different carbon source, but they were needed until a new, more diverse



EOSi studied the nitrogen uptake rate (NUR) of the denitrifying sludge using these bench scale reactors.

population of denitrifying organisms could be established and acclimated to MicroC®. EOSi had to develop a transition strategy that would taper the methanol feed while ramping up the MicroC 2000 feed, maintaining regulatory compliance throughout the process.

A secondary concern was that phosphorus concentrations in the denitrifying system were very low. Phosphorus is a critical nutrient for microbial growth and development, but excess amounts of phosphorus in the environment can harm water quality, a particular concern in Florida's wetlands.

The treatment plant was using sodium aluminate to chemically remove phosphorus from the wastewater before it flowed into the denitrification system.

MicroC® Premium Carbon Sources

FIGURE 1 Effluent nitrogen concentrations stabilized within approximately 2 weeks and met permit requirements throughout the transition period.

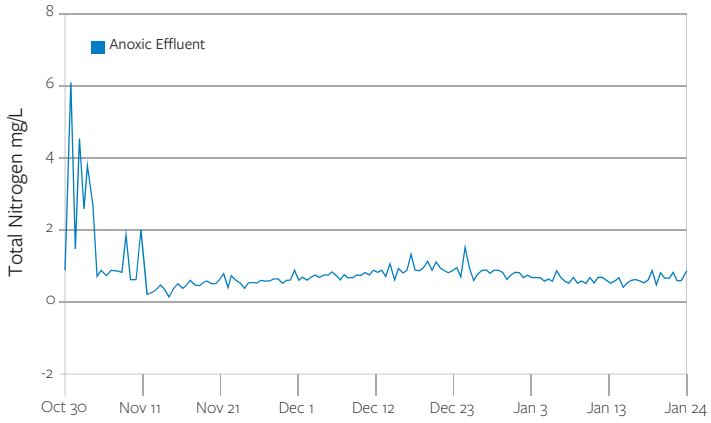
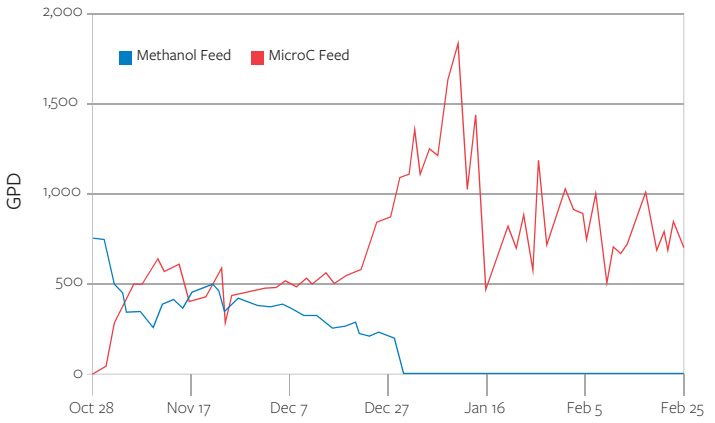


FIGURE 2 MicroC® usage was ramped up as methanol usage was reduced, and stabilized toward the end of the transition as the automated feed system was optimized.



Although the existing denitrifying sludge didn't show signs of a phosphorus deficiency, the higher biomass yield from MicroC would likely require higher phosphorus concentrations.

Solution Summary

Evaluation & Planning: The treatment plant remained in compliance with all effluent discharge requirements for nitrogen throughout the three-month transition, with EOSi helping plant operators plan and execute their successful transition to MicroC® 2000.

EOSi performed baseline monitoring and transition. EOSi installed in-line ultraviolet nitrate probes at strategic points in the denitrification system to monitor real-time performance and better understand the nitrogen profile. EOSi also tested grab-samples for microbial nutrients and other operational parameters. Results indicated that nitrogen loadings to the denitrification system followed a distinct diurnal pattern, and that influent phosphorus concentrations may have been too low to support a biomass being fed MicroC.

EOSi next conducted a BioWin simulation using EnviroSim's wastewater treatment process simulator for testing integrated biological, chemical, and physical process models. The BioWin simulation confirmed a phosphorus deficiency in the second anoxic zone, indicating that the sodium aluminate feed required adjusting as part of the transition to MicroC.

EOSi performed bench scale denitrification studies on the existing sludge. EOSi's laboratory set up two reactors, one fed with methanol and the other with MicroC 2000. After establishing anoxic conditions, each reactor was spiked with nitrate and then monitored for denitrification. The denitrification rate in the reactor fed with MicroC was much slower, confirming that the existing sludge was highly acclimated to methanol.

Study results also indicated that the existing sludge could achieve full denitrification when fed MicroC 2000, but only at the average wastewater flow rate and residence time. At higher flow rates, effluent nitrogen concentrations would not meet permit requirements. These results prompted EOSi to take a very conservative approach to transitioning from methanol to MicroC.

Transition to MicroC® 2000: EOSi designed a 4-phase transition from methanol to MicroC® 2000. Figure 1 shows effluent nitrogen concentrations during the 3-month transition. The treatment plant remained in compliance with all effluent discharge requirements for nitrogen (daily, weekly and monthly) during the transition.

Phase 1: The methanol feed was slowly decreased while the MicroC feed was slowly increased, as shown in Figure 2. Both chemicals were fed in manual mode, and plant operators and EOSi communicated daily for identifying and addressing underfeed or overfeed conditions. Effluent nitrogen concentrations stabilized at <1 mg/L after approximately 2 weeks.

Toward the end of Phase 1, plant operators switched to a dual-feed strategy with a higher feed rate for part of each day. This helped trim peak loads given the diurnal pattern of nitrogen loading. Plant operators also adjusted the sodium aluminate feed to increase phosphorus concentrations in the denitrification system.

Phase 2: MicroC continued to be fed in dual-feed manual mode, with the methanol feed shut off. Effluent nitrogen concentrations remained stable at <1 mg/L.

Phase 3: The MicroC feed switched to automatic mode.

Phase 4: EOSi provided technical assistance to plant staff with their feed control programming to optimize MicroC usage.

MicroC® Benefits

The treatment plant was using sodium aluminate to chemically remove phosphorus from the wastewater before it flowed into the denitrification system. Although the existing denitrifying sludge didn't show signs of a phosphorus deficiency, the higher biomass yield from MicroC® would likely require higher phosphorus concentrations.

In addition, unlike methanol, MicroC supports biological phosphorus removal. The treatment plant has shut off the sodium aluminate feed previously needed for chemical treatment of phosphorus. EOSi continues to support this plant with optimization as needed to minimize MicroC 2000 usage while maintaining regulatory compliance.

Methanol and MicroC® 2000	MicroC® 2000		
Phase 1: Manual Feed for Both	**Phase 2:** Manual Feed	**Phase 3:** Automatic Feed	**Phase 4:** Optimization